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Comparative Economic Analysis of Laser Land Leveling and Conventional Land Leveling on Wheat Crop

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Abstract.
This research set out to evaluate wheat yields using both traditional field leveling techniques and laser land leveling technologies. The greatest cost of land leveling was the primary reason why the total cost of wheat using laser leveling technology was so much higher than the traditional way. Using laser leveling technology resulted in a high yield of 45 mds/acre, as opposed to the traditional way of sowing's 38 mds/acre. Wheat farmers who used laser leveling to ensure equal watering and fertilization earned 46260 rupees per acre compared to 39178 rupees per acre for their efforts. The study also found that compared to traditional producers, those who used laser leveling technology to cultivate wheat had a better gross margin of 23250 Rs/acre. In order to cope with the water scarcity crisis and put this water savings to good use, laser leveling technology was used, resulting in a 21 percent reduction in irrigation water use.

Introduction

Wheat, being the main food of the people, has a prominent place in Pakistan's Agricultural Policy and is the country's most important food crop. Area planted with wheat was 90.3 million acres, and output was 25. 3 million metric tons; this accounts for 10.3 percent of agricultural value added and 2.2 percent of GDP (Economic Survey of Pakistan 2013). As the world's population rises, bread wheat is likely to become more important as a means of mitigating the resulting food crisis. However, during the grain filling phase, dryness is a common problem for wheat harvests in arid and semiarid locations with a Mediterranean climate.

Increasing numbers of farmers are abandoning time-consuming and costly conventional land-leveling techniques in favor of more efficient and cost-effective contemporary alternatives. By adjusting the drag buckets' lasers to the average height of the land, the surface may be leveled to within 2 centimeters. This method has the potential to reduce water use and increase crop yields, making it more popular (Jat M. L., 2006). Leveling the soil properly before planting or tending to crops saves time and energy later on. It reduces weeds and water use in field preparation while increasing yield and uniformity of crop maturity. Utilizing laser field leveling has been shown to reduce water use by 15-30% across a wide range of crop types and planting schemes (conserveagri.org, 2009). By using less water for irrigation, or "deficit irrigation," farmers may increase their crop yields without increasing their overall water usage. There is a period of time or the whole growing season when the crops are under stress from a lack of water. It is anticipated that the advantages of using the conserved water to irrigate other crops would outweigh the potential decrease in output (Kirda, 2000).

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Losses in the tertiary irrigation system and during application to crops account for over half of the total available irrigation water (Gill, 1998). When fields aren't leveled and field ditches aren't filled in, a lot of irrigation water goes to waste.

Water efficiency, crop establishment, irrigation time, and management effort may all be improved with proper field leveling. Proper field leveling enhanced crop productivity by 24% and decreased weed issues by 40%, according to research done at Punjab Agricultural University (PAU), Ludhiana (Rickman, 2002).

The use of lasers to level farmland is a relatively new resource-saving technique in India. The study's findings are quite promising. An improvement in agricultural productivity may be possible as a result of using precision field leveling to improve water application efficiency (Ahmed etal., 2001).

The use of a laser-assisted precision land leveling device may increase farmable land by 3–6%. (due to reduction in bunds and channels in the field). It is also well-known that many crop establishment strategies, including zero tillage, raised bed planting, and surface sowing, work far better on laser-levelled fields (Jat et al., 2006).

Irrigation water and energy savings of 24% and yield increases of 4.25% are possible for farmers that use laser leveling.

greater returns. The usual approach of irrigation was replaced with one that lowered costs by 44% while increasing water production by 39%. (Kaur B et al., 2012).

Most farmers in the nation still use outdated methods of farming, which has a negative impact on agricultural yield. In addition, the growing price of gasoline and other agricultural inputs has greatly multiplied the cost of production. To a large extent, this is because water is not being used efficiently in the current agricultural production methods. Due to very inefficient input utilization, natural resources have been wasted and depleted, and the ecosystem has deteriorated (Hobbs, et al. 1997).

Effective land leveling aims to maximize water usage efficiency, boost crop establishment, and cut down on irrigation time and labor needed to maintain crops. The purpose of the Manual for Laser Land Leveling is to train farmers and operators to use laser technology to obtain a level field surface, and to explain the advantages of land leveling in fields, especially rice fields. Its goal is to teach its readers how to set up, operate, and troubleshoot a laser-controlled land leveling system, as well as how to conduct a topographic survey using a laser system. As a first step toward better agronomic, soil, and crop management, it is intended that this guide will help users (farmers and service providers) embrace this crucial resource-conserving technology. Precision land leveling to within +2 cm is now possible thanks to laser technology (Waker, 1998).

Some farmers in Sindh have begun using laser leveling in recent years. However, there is a lack of data that would prove its effectiveness in increasing agricultural output and decreasing water use. Therefore, it was deemed necessary to analyze how laser land leveling compares to more conventional methods in the Sindh wheat system.

Objectives

The aims of the research were as follows:

The purpose of this study is to evaluate the cost-benefit of using laser leveling technology vs traditional field leveling for a wheat crop in Sindh.

In order to calculate how much money was spent on fertilizer, how well weeds were kept under control, and how much money was made from the crops.

To improve laser land leveling technology in Sindh, a variety of policy measures and program efforts will be developed.

Methodology

The information was gathered directly from the farmers in the Wheat-growing region of Sindh. Data collection, storage, and analysis steps are all outlined in the approach. Costs for cultivating crops are totaled up in the end.

Its Origins as a Data Source

Primary documents were used as the data source for this analysis. Wheat farmers responded to a well designed and field-tested questionnaire to provide the bulk of the study's core data. The data was taken in the growing season of 2012-2013. A survey of farmers was used to gather data on how laser levelers affect irrigation and yields.

Research Field

The study was carried out in Mirpurkhas and Tando Allahyar, two key districts in Sindh's wheat farming zone. Farmers who reported using laser levelers on their farms were prioritized for inclusion in this study.

Synthesis of Data

Data were cleaned up and imported from the surveys into a spreadsheet database when collection was complete. Numbers assigned to questions in the survey provide the basis for the variable names used inside the database. The purpose of this study is to evaluate the effect of laser leveling equipment on the efficiency with which water is used and the yield of crops. The purpose of this production cost study is to evaluate the efficiency of traditional leveling methods versus laser leveling equipment.

A Look at Farming Expenses

Using data from both traditional and laser leveling methods, we calculated the total cost of farming. This research will allow for a direct comparison of laser leveling technology's overall costs and returns to those of more traditional ways. The opportunity costs for the farm's owned factors of production are added to the profit and loss account expenditures (cash expenses, depreciation, etc). (family labor, own land, own capital).

Sum of the Money Made

The sum of money made through selling a product or

service. To determine revenue, multiply the selling price by the total number of units sold. (Total Profit = Selling Price * Unit Sales) (Biz 2002).

Sum total

Any level of production incurs a total cost equal to the sum of its fixed costs plus its total variable costs, or fixed costs plus total variable costs. Expenses in the farming industry are often broken down into a few primary groups. Here are some examples of cost ideas that are often seen in everyday life. *Amount of fixed expenses*

The sum of all fixed expenses is called "fixed costs," and it remains constant regardless of output. The expenses associated with a building's ownership are still paid for whether it is completely vacant, just half filled, or completely overflowing.

All of the variable expenses

The sum of all variable expenses is what moves up and down in direct proportion to the amount of work done. The price of animal feed is an example of a variable cost. Feed expenditures are avoided and the livestock building's fixed costs remain even if the animal isn't bought.

Expenses forgone due to missed opportunities

Opportunity costs are the losses that result from not putting a resource to its highest and greatest use. For instance, if he farmed his own property, he lost out on income he might have gotten by renting it out (Hofstrand 2005).

A company's profit is the result of subtracting its entire operating expenses from its gross income. Profit=GR-TC

GR = Grass Tax T C = Total Expenditures Net gain in the books

Expenses, including opportunity costs, are removed from revenue to determine net income for accounting purposes. The term "net farm income" is synonymous.

Gain in the economy

After deducting all expenses, including the opportunity costs of the operator's labor and capital, economic profit is the amount left over. It's equivalent to saying "get back to management" (Hofstrand 2005). Revenue Gains

When determining a company's gross margin, one must first determine the whole amount of revenue received before deducting the total amount of variable expenses. Agricultural businesses often declare their gross margins in terms of rupees.

GM=TR-TVC

Gross Margin Equals Net Profit When referring to financial performance, TR stands for "total returns." Total Costs of Variables = TVC.

Cropping Patterns as a Final Outcome

Rabi and Kharif are the names of two separate growing seasons. The months of October through March constitute the rabi harvesting season. Starting in late April or early May and lasting until the end of September is the Kharif season. In the Rabi growing season, around 34.66% of the land was devoted to wheat cultivation in the research region.

Table 1. Cropping Patterns

Seasons	Area (acres)	percentage of Operational holding
Rabi		
Wheat	20.9	34.66
Sugarcane	14.1	23.38
Rabi fodder	2.6	4.31
Rapeseed	3.46	5.74
Oil seed	2.33	3.86
Vegetable	3.62	5.34
Orchard	4.67	10.40
Fallow land	8.62	14.30
Kharif		
Cotton	21.5	35.66
Sugarcane	13.9	23.05
Kharif fodder	2.56	4.25
Rice	0.31	0.51
Vegetable	7.26	12.04
Orchard	5.67	9.40
Fallow land	9.1	15.09

Production Technology Cost

Table 2 displays the findings of the cost of production, which are separated into cash costs and non-cash costs (depreciation and opportunity costs) for production elements that are held by the wheat farmers. Wheat planting using laser leveling technique resulted in significant cash expenditures, at Rs. 20,314/acre.

costing Rs. 18906 per acre for standard wheat planting. Cost per acre for land leveling is higher for wheat planted using laser leveling technology ($1721) than for conventional wheat planting ($970) when it comes to cold hard cash..

Table 2. Cost of Production of Wheat by Conventional and Laser Leveling Technology (Rs/acre)

		Costs	Conventional	Laser leveling
Cash Costs	Variable Costs	Labour Cost		
		Land Leveling	1170	1921
		Plough	2445	2564
		Harvesting	1790	1784
		Threshing	1116	1126
		Loading /Unloading	314	347
		Total Labour Costs	6835	7742
		Factor Costs		
		Seed Cost	2548	2606
		Fertilizer		
		DAP	3060	3147
		Urea	3882	3998
		NP	987	991
		Weedicide	492	515
		Tube well irrigation	640	480
		Threshing charges	2562	2875
		Transportation	596	656
		Total Factor Costs	14767	15268
		Total Variable Costs	21602	23010
	Fixed Costs			
		water Charges	97	97
		Govt. Land Taxes	207	207
		Total Fixed Costs	304	304
	Total Cash Costs		22210	23618
Non-Cash Costs	Opportunity Costs			
		Rent of Own Land	12016	12016
		Irrigation labour	545	355
		Total Opportunity Costs	12561	12371
	Total Non-Cash Costs		12561	12371
Total Costs			34771	35998

Total Revenue of Wheat:

Using laser leveling technology resulted in a higher yield of 45 mds/acre compared to the traditional way of wheat cultivation, which yielded only 38 mds/acre (as shown in Table 3). Growers of wheat said that they were able to increase their crop's output because to their consistent and uniform use of irrigation and fertilizer application tools, including laser leveling equipment. Wheat farmers using traditional methods and those using laser leveling technology each saw prices of Rs.1031/md and Rs.1028/md, respectively.

Based on an analysis of the economic value of wheat, it was determined that farmers who used laser leveling technology earned 46260 rupees per acre more than their traditional farming counterparts (who earned 39178 rupees per acre).

Table 3. Average Yield, Price and Total Revenue of Wheat Production by Technology during, 2012-13

	Conventional	Laser leveling
Average Yield (Mds/ Acre)	38	45
Average Price (Rs./mds)	1031	1028
Total Revenue (Rs./acre)	39178	46260

Profit of Wheat by Technology

Profits from accounting and economic perspectives for wheat production are summarized in Table 4. Laser leveling technology farmers had the greatest accounting profit of Rs. 226,42/acre and the highest economic profit of Rs. 10,262/acre. Comparatively, traditional farmers made Rs. 16968 and Rs. 4407 per acre in economic and accounting profit.

Table 4. Profit of Wheat Production by Technology (Rs./acre)

	Conventional	Laser leveling
Total Revenue	39178	46260
Total Cost	34771	35998
Opportunity Cost	12561	12371
Accounting Profit	16968	22642
Economic Profit	4407	10262

1 . - Total Cost = Cash cost + Non cash cost, (Total cost is already included opportunity cost).

Gross Margin of Wheat

Gross margin is calculated by dividing revenue by variable expenses. Labor and factor expenses are added together to get total variable costs.

Table 5 demonstrates that the gross margin attained by wheat farmers using laser leveling technology was Rs. 23250/acre, whereas the gross margin attained by traditional growers seemed to be lower at Rs. 17576/acre.

Table 5. Gross Margin of Wheat by Technology during (Rs/Acre)

	Conventional	Laser leveling
Total Revenue(Rs/Acre)	39178	46260
Total Variable Cost(Rs/Acre)	21602	23010
Average total labor cost(Rs/Acre)	6835	7742
Average total factor cost(Rs/Acre)	14767	15268
Average gross margin(Rs/Acre)	17576	23250

Discussion

Biotic and abiotic factors, as well as social structure, resource availability, and a functional marketing system, are essential for the successful cultivation of any crop. In light of this, it is thought to be instructive to briefly compare the land used for wheat cultivation using laser levelers and traditional methods in different regions of Sindh, Pakistan, in terms of both area and output.

Based on the results of the study, the total cost of wheat produced using laser leveling technology is higher than that of traditional wheat. Using laser leveling technology resulted in a high yield of 45 mds/acre, as opposed to the traditional way of sowing's 38 mds/acre. Wheat farmers have reported higher yields thanks to the use of laser leveling equipment, which ensures that water and fertilizer are applied uniformly over the field. Wheat farmers using laser leveling technology earned 46260 rupees per acre in total earnings, whereas their traditional farming counterparts brought in just 39178 rupees per acre. The study also found that farmers who used laser leveling technology to cultivate their wheat had a greater gross margin per acre, at 23250 Rs/acre, than their conventionally-grown counterparts, at 17576 Rs/acre. Most farmers are eager to adopt laser technology because of the excellent yield it provides while also reducing their need for irrigation water. There has been a three-year research comparing the effects of laser land leveling to those of conventional land leveling on productivity in terms of both water consumption and agricultural yields in Western Uttar Pradesh, and the results are contrasted here. The primary issues were whether or not laser land leveling was useful as a water-saving strategy in the modern context of land usage and ownership, whether or not farmers could afford the technology, and whether or not it was economically viable. Researchers found that using laser leveling helped farmers increase yields of rice (6.6 percent), wheat (5.4 percent), and sugarcane (10 percent). Compared to conventionally leveled fields, we were able to cut overall irrigation time in half for rice, by 14.7 percent for wheat, and by 20 percent for sugar cane. The water usage efficiency (WUE) of laser-leveled fields was 48% greater than that of control (unleveled) fields, 47% higher than that of precisely leveled fields, and 49% higher than that of conventionally leveled fields. Water production in rice and wheat on average

and sugarcane yields have increased by 33%. Compared to conventionally leveled fields, laser fields increased yearly net revenue by 14, 13, and 23.8% for rice, wheat, and sugarcane, respectively. Researchers in western Uttar Pradesh found that laser land leveling improved agricultural yields and reduced irrigation water needs across a variety of farming systems.

Overall, yield was 45 mds/acre higher when employing laser leveling technology compared to the traditional way of sowing (38 mds/acre) and the results demonstrate that most farmers are eager to adopt this new technology. When compared to the traditional method's 39178Rs/acre, the total income achieved using a laser leveler was 46260Rs/acre. Wheat sown using laser leveling technology had a total cost of 35998Rs/Acre, which was more than the traditional wheat sowing method's cost of 34771Rs/Acre but still lower than the cost of preparing the field for planting by hand.

Conclusion

The research was carried on the comparison of laser leveler technology and conventional techniques of wheat crop of Sindh. The information was acquired from chosen wheat producers based on field survey. The core data was acquired via personal interviews. Number of analytical methodologies was employed to obtain comparative economic study of laser leveling technology and traditional land leveling technology of wheat crop in Sindh \si.e. farm cost analysis, gross margin analysis.

Study demonstrates that total cost of wheat using laser leveling technology was high as compared to traditional wheat owing to highest land leveling cost. Using laser leveling technology resulted in a high yield of 45 mds/acre, as opposed to the traditional way of sowing's 38 mds/acre. Wheat farmers have reported higher yields thanks to the use of laser leveling equipment, which ensures that water and fertilizer are applied uniformly over the field. Wheat farmers using laser leveling technology earned 46260 rupees per acre in total earnings, whereas their traditional farming counterparts brought in just 39178 rupees per acre. Study findings further reveal that laser leveling technology wheat producers achieved larger gross margin 23250 Rs/acre, as compared to traditional growers 17576 Rs/acre

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